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RELATIVE ECONOMICS OF MAJOR CROPS UNDER TANK REHABILITATION INTERVENTIONS OF JALA SAMVARDHANE YOJANA SANGHA (JSYS) IN CHITRADURGA DISTRICT OF KARNATAKA STATE

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ABSTRACT

The study was conducted in Chitradurga district of Karnataka State to access the importance of Jala Samvardhane Yojana Sangha (JSYS) interventions in rehabilitation of community based tanks during 2011. The study was based on the primary data from 120 sample respondents for the period 2010-2011. The secondary data was collected from JSYS, Bangalore. The cost of cultivation per acre was highest in paddy crop with Rs. 20978, Rs. 21791 and Rs. 22005 in collective action plus action research (CAPAR), collective action only (CAO) and control respectively. Return per rupee investment was highest in case of maize with 1.37, 1.22, 1.13 in CAPAR, CAO and control respectively. Net return over variable cost of ragi per acre was Rs. 4639, Rs. 3301 and Rs. 2507 in CAPAR, CAO and control respectively. Per farm gross returns have enhanced by Rs. 22165 in CAPAR and Rs. 10361 in CAO than control. The contribution of collective action and action research together was Rs. 4415 per acre where as the contribution of research was Rs. 2351 per acre. Every hectare centimeter of water applied through CAPAR realized a higher gross return of Rs. 97.72.

KEYWORDS: *Jala Samvardhane Yojana* Sangha, Cost of Cultivation, Return per Rupee Investment, Net Return over Variable Cost, Per Farm Gross Returns

INTRODUCTION

Of the 329 million hectare total geographical area in our country 142 million hectare is under cultivation, of which 96.56 million ha area is rainfed (68.60%). Rainfed agriculture supports nearly 360 million people of Indian sub-continent. Bulk of production of pulses, oil seeds, millets, coarse grains and commercial crops like cotton is contributed from rainfed agriculture. Thus, rainfed agriculture has a greater prospect of contributing substantially to the country's food production and unless the production from the rain fed area increases, the real breakthrough in agriculture may not be possible.

One of the earliest modes of surface water harvesting was construction of small water bodies called as tanks, to store rain water during the monsoon period. They were considered as the lifeline of villages and were treated as sacred places by the village communities, and were managed collectively, using local resources and technologies. Given the political economy considerations in the post-independence period, the operation and management of tanks was gradually taken over by the government. There are many socioeconomic and political reasons for the decline of tank irrigation systems. People lost the interest or the relation with the tanks since they were unaware of their benefits in the past. People are also of the attitude that the community tanks must be taken care by the government while the benefits from the tanks should be enjoyed by them. As a result, the storage capacities of the tanks have gradually reduced adversely affecting their irrigation potential.

Karnataka, on one hand evinces a critical need for rejuvenation of tank systems to restore their storage capacity and on the other, faces a resource crunch to take up the required repairs and reconstruction of these tank and similar civil structures. Taking the contemporary problems and constraints for efficient management of tanks into account, it was felt that the responsibility of tank management should be handed over back to the local communities as it was there in traditional system of tank management. As a pre-requisite there is need for systematic rehabilitation of the entire tank infrastructure before handing over to the community, which obviously calls for huge investment. The tank systems have deteriorated to a large extent due to lack of timely repairs, maintenance and reconstruction. The Government of Karnataka has, therefore, approached the World Bank for assistance to take up the tank rehabilitation programme in the state. It is in this background, the Karnataka Community Based Tank Management Project (KCBTMP) has been started on a pilot basis, during the year 2002-03 with the financial assistance from the World Bank.

Jala Samvardhana Yojana Sangha (JSYS)

Jala Samvardhana Yojana Sangh (JSYS) was established as a nodal agency to promote this task in the State under the Department of Minor irrigation in June 2002. Tanks have been the symbol of water harvesting tradition in Karnataka since centuries. There are about 36,672 tanks in Karnataka. Tank systems have contributed to the sustainability of ecology, environment and rural livelihoods since centuries. The tank system with a potential to irrigate 6,90,000 ha of the command area acts as a major contributor for stabilization of groundwater status in majority of semi-arid zones of the state that are in despair due to lack of management resulting in physical degradation and declined operational performance.

JSYS has the responsibility of forming peoples' committee towards rehabilitation of tanks as social institutions to rehabilitate and hand over them to the target tank users. By adopting a participatory system, JSYS intends to promote and organize the activity of the capacity building as well as providing logistic support. JSYS plans to seek the help of NGO's for training and orientation of the target tank users. JSYS has moved from desiltation to Integrated Tank Development.

KCBTMP was launched in nine districts of Karnataka state comprising Bidar, Bellary, Raichur, Tumkur, Kolar, Chitradurga, Koppala, Bagalkot and Haveri. (UAS) Bangalore and Dharwad have been given the responsibility of enhancing agriculture productivity and improving water use efficiency in the districts coming under their respective operational jurisdictions. The activities include, On-farm demonstrations, Training activities, Promotion of Income generating activities, Samudaya tantrika vedike and Participatory technology development.

METHODOLOGY

Chitradurga is one among the ten districts selected by JSYS for intervention under tank rehabilitation. So, Chitradurga was purposively selected for the present study as a major portion of its cultivable land depends on rainfall for agriculture, which is of about 85 percent and irrigation accounts for only 15 percent of the cultivable area. The JSYS interventions are being taken up in all the six taluks of Chitradurga district. About 120 sample respondents were selected for the study. There were three scenarios of intervention, so 40 sample respondents were selected representing each scenario. The first scenario had both collective action and action research (CAPAR), second scenario had only collective action (CAO) and third scenario was control.

Primary information for the reference period 2010-2011 was collected by using pre-tested interview schedule, applying face–to-face interview method. For evaluating the objectives of the current investigation, the analytical techniques used are summarized as below.

- **Economics of Crop Cultivation**

To study the economics of crop cultivation, tabular analysis was used. In the present study all calculations pertaining to the economics of crops were made on per acre basis.

The total costs were divided into two broad categories:

- Variable Costs
- Fixed Costs

- **Variable Costs**

The variable costs include cost of seeds, manure, fertilizers, wages of human and bullock labour, plant protection chemicals, irrigation, interest on operational capital and repair and maintenance charges.

- **Seeds**

The cost of purchased seeds was based on the actual amount paid by the respondents.

- **Farm Yard Manure**

The locally prevailing price per tonne was used to impute the value of farmyard manure produced on the farm.

- **Fertilizers and Plant Protection Chemicals**

The cost of fertilizers and plant protection chemicals were based on actual prices paid by the farmers including the cost of transportation and other incidental charges, if any.

- **Labour**

The cost of hired labour was calculated at the prevailing wage rates paid per day (8 hours) in the study area for men, women and bullock labours and machine labour during the study period. The cost of family human labour, animal and machinery was calculated considering the prevailing market rate in this region through imputation.

- **Irrigation Cost**

The irrigation cost on acre basis is worked as follows;

$$\text{Cost per acre inch of water} = \frac{\text{Total amortized cost of irrigation}}{\text{Total number of acre inches of water used}}$$

The number of acre inches of water extracted for each crop in each season = frequency of irrigation per month * Number of months of crop * Number of hours to irrigate the crop area* average yield of bore well in GPH / 22611.

The amortized cost of irrigation = (The amortized cost of irrigation well + Amortization cost of convenience + Amortization cost of pump set and accessories + Amortization cost of repair and maintenance).

Thus, the cost of irrigation for the crops is worked out by multiplying the amortized cost of irrigation with number of acre inches of water used. This total cost of irrigation is then apportioned to include individual crops according to

the proportion of water used in each crop:

- **Amortized Cost of Well**

In order to arrive at the irrigation cost, the well investment has been amortized. It varies with amount of capital investment, age of the well, interest rate, year of construction. Amortization cost of well was worked out by adopting the following procedure,

Amortized cost of bore well = [(Compounded cost of bore well) * $(1+d)^{AA}$* d]÷[$(1+d)^{AA}$-1]

Where

AA= Average Age of bore well

BW = Bore Well

d = Discount rate considered at 2 per cent

Compounded cost of BW= Historical cost of BW* $(1+i)^{(2011- \text{ year of drilling})}$

Where

i = Compound rate of 2 per cent

Amortized cost of Drip irrigation system = [(Compounded cost of Drip system) * $(1+d)^{AA}$* d]÷[$(1+d)^{AA}$-1]

Compounded cost of Drip system =

Historical cost of drip system* $(1+i)^{(2011- \text{ year of installation of drip system})}$

A modest discount rate of two per cent is considered for amortizing the cost of irrigation well to represent the compound rate of interest in the costing well components like construction cost, drilling cost, pump set, and accessories and so on.

- **Water Use in Each Crop**

The number of acre-inches of water used for each crop in each season (summer, *Kharif*, *Rabi*) = [(area irrigated in each crop) * (frequency of irrigation per month) * (number of months of crop) * (number of hours for one irrigation) * (Average yield of well in GPH)] ÷ 22611

For instance, the water used for irrigation in coconut (acre inches) in Drip irrigation is then = {Number of drips per acre X No. of hours to drip irrigate the cropped area once X water discharged per dripper (in liters per hour) X Duration of crop irrigated in months X frequency of irrigation per month (in number) X 0.22/22611}

Interest on Operational Capital

The working capital consists of the expenditure on labour, seedlings, farm yard manure, fertilizers and plant protection chemicals and materials. Interest on operational capital was calculated at the rate of seven per cent per annum (the rate at which commercial banks advance short term loans) for six months as the capital is used at different stages of crop production and was apportioned to the crop based on the duration of the crop.

- **Fixed Costs**

These include depreciation on farm implements and machinery, interest on fixed capital, land revenue.

The measurement and definitions of fixed cost components are as follows.

- **Depreciation Charges**

Depreciation on each capital equipment and machinery owned by the farmers and used for land cultivation was calculated for individual farmer based on the purchase value using the straight line method. Thus the

$$\text{Annual depreciation} = \frac{\text{Purchase value} - \text{Junk value}}{\text{Useful life of the asset}}$$

The average life of the asset as ascertained through consultation with farmers was used in the computation of the depreciation. The depreciation cost of equipment was apportioned to the crop based on its percentage use.

- **Interest on Fixed Capital**

Interest charges on fixed capital were calculated at the rate of nine per cent, as the fixed deposits in commercial banks would fetch this rate of interest. The items considered under fixed capital are implements and machinery. Interest was considered on the book value of these assets i.e. the value arrived at after deducting the cumulative depreciation for each year of use in the purchase value of the asset up to the year of study.

- **Land Revenue**

Actual land revenue paid by the farmers was considered.

- **Rental Value of Land**

The prevailing rental value of the land in the study area was considered separately for irrigated and dry land separately.

- **Total Cost of Cultivation**

It is the sum of variable costs and fixed costs and expressed on per acre basis.

- **Ratio of External to Internal Resources**

Worked out by taking the value of external resources which are brought from outside the farm for which payment is made such as seeds, fertilizers, hired labours, plant protection chemicals etc to the resources which are used from the farm origin.

- **Output and Returns**
  - **Gross Returns**

Return obtained by multiplying the output with the value of the output prevailing in the market. It included the returns from the main and by-products as well calculated at actual price or imputed at those prices if the products were used for self consumption.

- **Net Returns on Variable Costs**

  It is the gross returns minus variable costs.

- **Net Returns on Cost of Cultivation**

  It is the gross returns minus variable costs plus fixed costs.

- **Returns per Rupee of Investment**

Worked out by taking the ratio of Gross return to cost of cultivation.

$$\text{Return per rupee of investment} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

- **Relation between the Gross Returns of Farmers in Three Scenarios**

It is hypothesized in this study that the gross return of the farmers from three scenarios of intervention is determined by the explanatory variables such as 1) gross cropped area in acres, 2) labour (men and women) employed in production, 3) capital used in production such as the cost incurred for purchase of other inputs, machine and hired labour employed, 4) water applied to the crops in hectare centimeters

The intervention scenarios are determined by two dummy variables such as:

Farmer from collective action plus action research = (1, 0)

Farmer from collective action only = (0, 1)

Farmer from control (no collective action plus action research) = (0, 0).

Slope dummy is used in regression function to capture the contribution of each hectare centimeter of water applied through two scenarios of interventions. Dummy 1 (1, 0) is multiplied with the water applied (X_4) per farm in hectare centimeters and dummy 2 (0, 1) is multiplied with the water applied (X_4) per farm in hectare centimeters.

Water applied through CAPAR = $(1, 0)*X_4$

Water applied through CAO = $(0, 1)*X_4$

Water applied through control= $(0, 0)*X_4$

The linear model proposed is as under:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5D_1 + b_6D_2 + b_7D_1X_4 + b_8D_2X_4 \quad \ldots\ldots(1)$$

Where

Y = Gross return obtained (Rs/farm)

X_1 = Gross cropped area (acre/farm)

X_2 = Labour used in production (Rs/farm)

X_3 = Capital used in production (Rs/farm)

X_4 = Water applied to crops (hectare centimeter/farm)

D_1 = Dummy variable for CAPAR farmer (1, 0)

D_2 = Dummy variable for CAO farmer (0, 1)

From the linear model above, the increase in the gross returns for the three scenarios of farmers sampled in this study namely collective action plus action research, only collective action, and control where no collective action and action research will be estimated.

RESULTS AND DISCUSSIONS

- **Relative Economics of Paddy**

The results of costs and returns per acre of paddy crop are shown in Table 1. The total cost of cultivation was highest in case of control with Rs. 22005 where as it was lesser in CAPAR scenario with Rs. 20978 and Rs. 21791 in CAO scenario. This was because of the various technologies taught by JSYS and CBTMPCS and the infrastructure developed by the JSYS. The technologies aimed at judicious use of the resources so the cost of cultivation had came down. The cost of seed was only Rs. 319 in CAPAR scenario where as it was Rs. 382 in control. The arable crop demonstration and water management demonstrations which were taken on paddy crop in the farmer field had taught them to go for reduced seed rate with high yield. Micro nutrient and the soil amendments accounted for Rs. 230 from CAPAR scenario, Rs. 162 in CAO scenario where as only Rs. 21 in control scenario. This was mainly because of the trainings given to the farmers of CAPAR and CAO Scenarios. The technologies given by the JSYS and CBTMPCS explained the farmers regarding the balanced nutrients through integrated nutrient management with the combination of FYM, fertilizers, green manure and silt. So the cost of fertilizers was only Rs. 1470 in CAPAR scenario, Rs. 1531 in CAO scenario where as in control it was Rs. 1598 because of the lack of technical knowledge. Because of the timely agricultural operations the farmers from CAPAR scenario and in CAO scenario incurred quite low labour cost of Rs. 11202 for CAPAR scenario and Rs. 11425 for in CAO scenario, whereas it was Rs. 11857 for control group. The yield was highest in case of CAPAR scenario with 22.86 quintals then in CAO scenario with 2248 quintals where as in control scenario it was 21.79 quintals because of the high yielding seeds used and the technologies such as application of soil amendments and micro nutrient, INM and timely management of operations. Since the cost was lower and the yield was higher in case of CAPAR scenario the returns were generally higher where as it was vice versa in control scenario. Ratio of external to internal resources was highest in case of CAPAR scenario with 1.33 then in CAO scenario with 1.25 where as it was 0.98 in control. The return per rupee invested was highest in case of CAPAR scenario with 1.23 then in CAO scenario with 1.16 and lowest in control with 1.11 because of the less cost of cultivation and the higher yield in case of the CAPAR scenario, in CAO scenario and it was vice versa in control.

Table 1: Summary of Economics of Paddy in Three Scenarios (Rs. per Acre)

Particulars	CAPAR	CAO	Control
Seeds	319 (1.52)	335 (1.54)	382 (1.74)
FYM	1017 (4.85)	1053 (4.83)	1231 (5.59)
Micro nutrient & Soil amendments	230 (1.09)	162 (0.74)	21 (0.09)
Fertilizers	1470 (7.01)	1531 (7.02)	1598 (7.26)
Plant protection chemicals	92 (0.44)	119 (0.55)	105 (0.48)

Table 1: Contd.,			
Labours	11202 (53.40)	11425 (52.43)	11857 (53.88)
Irrigation cost	1147 (5.47)	1188 (5.45)	1584 (7.20)
Interest on working capital @ 7 %	502 (2.39)	512 (2.35)	532 (2.42)
Total variable cost	15979 (76.06)	16324 (74.91)	17309 (78.66)
Total fixed cost	5000 (23.83)	5497 (25.09)	4696 (21.34)
Total cost	20978 (100.00)	21791 (100.00)	22005 (100.00)
Yield–main product (Qtls)	22.86	22.48	21.79
-bi product (Qtls)	20.00	18.00	16.48
Gross returns	26002	25406	24523
Net return over variable costs	10023	9082	7214
Net return over all costs	5024	3615	2518
Ratio of external to internal resources	1.33	1.25	0.98
Returns per rupee invested	1.23	1.16	1.11

Figures in the parenthesis indicate percent to the total cost, CAPAR = collective action plus action research; CAO = collective action only

- **Relative Economics of Ragi**

The results of the relative economics of ragi are shown in table 2. The total cost of cultivation was highest in case of control with Rs. 10545 where as it was only Rs. 9781 in CAPAR scenario and Rs. 10485 in CAO scenario. There was less cost of cultivation in case of CAPAR scenario mainly because of the cost reduction and yield increasing technologies taught by JSYS and CBTMPCS. The introduced technologies aimed at judicious use of resources so the cost of cultivation had came down. The cost of seed in CAPAR scenario was Rs. 152, in CAO scenario it was Rs. 162 and in control it was Rs. 186. The arable crop demonstration was taken on ragi which taught them to go for reduced seed rate and high yielding technologies. Micro nutrient and the soil amendments accounted for Rs. 41 in CAPAR scenario, Rs. 16 in CAO scenario where as the control farmers didn't applied. The farmers in CAPAR scenario and in CAO scenario had the knowledge on balanced nutrient management where as it was not in case of control farmers. Because of the timely operations, labour use was less in case CAPAR scenario with Rs. 4726; in CAO scenario it was Rs. 5281 where as it was Rs. 5767 in case of control. The farmers from CAPAR scenario obtained the yield of 11.38 quintals; in CAO scenario farmers obtained the yield of 10.82 quintals where as the farmers from control obtained 10.42 quintals because of the high yielding technologies taught. The farmers gone for line sowing, high yielding seeds, balanced nutrient management etc. the yield of bi product was 17 quintal in CAPAR scenario; 15.65 quintal in CAO scenario where as 15.10 quintal in control scenario. The gross return was highest in case of CAPAR scenario with Rs. 12506; in CAO scenario with Rs. 11840 where as it was only Rs. 11409 in case of control. External to internal ratio was 1.08 in cases of CAPAR scenario; 1.25 in case of only CAO scenario and it was 0.97 in case of control. The farmer from CAPAR scenario and in CAO scenario used more of external resource than the internal resource. Returns per rupee invested was 1.28 in CAPAR scenario, 1.13 in CAO scenario where as it was only 1.08 in case of control. The farmers from CAPAR scenario and in CAO scenario got higher return per rupee

since they were exposed with high yielding technologies.

Table 2: Summary of Economics of Ragi in Three Scenarios (Rs. per Acre)

Particulars	CAPAR	CAO	Control
Seeds	152 (1.55)	162 (1.55)	186 (1.76)
FYM	1353 (13.83)	1349 (12.87)	1014 (9.61)
Micro nutrient & Soil amendments	41 (0.41)	16 (0.15)	00 (0.00)
Fertilizers	1007 (10.30)	1039 (9.91)	1221 (11.58)
Labours	4726 (48.32)	5281 (50.36)	5767 (54.68)
Irrigation cost	335 (3.43)	416 (3.97)	428 (4.06)
Interest on working capital @ 7 %	225 (2.60)	275 (2.62)	287 (2.72)
Total variable cost	7867 (80.44)	8539 (81.44)	8902 (84.42)
Total fixed cost	1943 (19.56)	1977 (18.57)	1674 (15.59)
Total cost	9781(100.00)	10485 (100.00)	10545 (100.00)
Yield–main product (Qtls)	11.38	10.82	10.42
-bi product (Qtls)	17	15.65	15.10
Gross returns	12506	11840	11409
Net return over variable costs	4639	3301	2507
Net return over all costs	2725	1355	864
Ratio of external to internal resources	1.08	1.25	0.97
Returns per rupee invested	1.28	1.13	1.08

Figures in the parenthesis indicate percent to the total cost, CAPAR = collective action plus action research; CAO = collective action only

- **Relative Economics of Maize**

The total cost of cultivation was highest in case of control with ` 15436 where as it was lesser in CAPAR scenario with Rs. 13897 and Rs. 14681 in CAO scenario as shown in table 3. This was because of the various cost reduction and yield increasing technologies taught by JSYS and CBTMPCS. The technologies aimed at judicious use of the resources so the cost of cultivation had came down. The cost of seed was only Rs. 333 in CAPAR scenario where as it was Rs. 379 in control.

Table 3: Summary of Economics of Maize in Three Scenarios (Rs. per Acre)

Particulars	CAPAR	CAO	Control
Seeds	333 (2.39)	342 (2.33)	379 (2.46)
FYM	1057 (7.60)	1112 (7.58)	1264 (8.19)
Micro nutrient & Soil amendments	43 (0.31)	26 (0.18)	00 (0.00)
Fertilizers	1228 (8.84)	1360 (9.26)	1418 (9.18)
Plant protection chemicals	34 (0.24)	42 (0.29)	54 (0.35)
Labours	4985 (35.87)	5730 (39.03)	6038 (39.12)
Irrigation cost	828 (5.96)	1060 (7.22)	966 (6.26)
Interest on working	269 (1.93)	301 (2.05)	320 (2.08)

capital @ 7 %			
Total variable cost	8775 (63.14)	9973 (67.81)	10440 (67.63)
Total fixed cost	5122 (36.86)	4708 (32.19)	4996 (32.37)
Total cost	13897 (100.00)	14681 (100.00)	15436 (100.00)
Yield–main product (Qtls)	17.56	16.6	16.1
-bi product (Qtls)	65	61	59
Gross returns	19061	18016	17443
Net return over variable costs	10286	8043	7003
Net return over all costs	5164	3335	2007
Ratio of external to internal resources	1.27	1.14	0.98
Returns per rupee invested	1.37	1.22	1.13

Figures in the parenthesis indicate percent to the total cost, CAPAR = collective action plus action research; CAO = collective action only

The demonstrations conducted on the fields of the farmers for paddy and ragi had created awareness and to realize the importance of optimum seed rate. Micro nutrient and the soil amendments accounted for Rs. 43 in CAPAR scenario, Rs. 26 in CAO scenario where as in control it was zero. The technologies given by the JSYS and CBTMPCS explained farmers the importance of integrated nutrient management with the combination of FYM, fertilizers, green manure and silt. So the cost of fertilizers was less in case of CAPAR and CAO. The yield was highest in case of CAPAR scenario with 17.56 quintal then in CAO scenario with 16.60 quintal where as in control scenario it was 16.10 quintal. Because of the lower cost and high yield in case of CAPAR scenario the returns were generally higher where as it was vice versa in control scenario. The net returns over variable cost and fixed cost was also higher in CAPAR scenario and in CAO scenario than in control. Ratio of external to internal resources was highest in case of CAPAR scenario with 1.27 then in CAO scenario with 1.14 where as it was 0.98 in control. The return per rupee invested was highest in case of CAPAR scenario with 1.37 then in CAO scenario with 1.22 and lowest in control with 1.13 because of the less cost of cultivation and the higher yield in case of the CAPAR scenario, in CAO scenario and it was vice versa in control.

- **Relation between the Gross Returns among Three Scenarios**

The selected linear model was found to satisfactorily explain the relationship between independent variables such as land, labour, capital and water used and the influence of intervention of JSYS, CAPAR study scenarios on the gross return. This is evident in the high and significant R^2 of 0.93, with F value of 206.30

When the coefficients are incorporated the model is

$$Y = 1316.88 + 12018.25x_1 - 0.62x_2 + 0.71x_3 + 196.81x_4 + 13965.86d_1 + 10354.18d_2 + 97.72d_1x_4 + 0.08d_2x_4 \quad (2)$$

As seen from the Table 4, the variables gross cropped area, capital and water applied were found to be significantly and positively influencing the gross returns. For every one acre increase in cropped area farmers gross returns increased to the extent of Rs. 12018 where as every one rupee of capital contributed around 0.71 rupees additionally to the gross returns. Similarly each additional hectare centimeter of irrigation water added to the crop increased the gross income

to the extent of Rs. 197.

Table 4: Linear Model Explaining the Relationship between Dependent Variable (Gross Return) and Independent Variables (Land, Labour, Capital and Water Applied)

Regressors	Coefficients	T Stat
Intercept	1316.88	0.29
Gross cropped area	12018.25*	10.76
Labour	-0.62	-1.58
Capital	0.71*	2.41
Water applied	196.81*	4.35
Dummy for collective action and action research scenario farmer	13965.86*	2.04
Dummy for only collective action scenario farmer	10354.18	1.58
Dummy for water applied in collective action and action research scenario	97.72*	2.20
Dummy for water applied in collective action scenario	0.08	0.01
R square, n = 120 farmers	0.93*	
Adjusted r square	0.93	
F-value	206.30	

***significant at 1 percent**

This implied that gross returns of the farmer under control scenario have been influenced positively by the resource used for cultivation of different crops. Even though contribution of labour was non significant it found to be negative in this regard.

However the gross return realized by the farmer through collective action along with action research has been greatly enhanced to the extent of Rs. 10354 in CAO and Rs. 13965 in CAPAR as shown in Table 4. This clearly implied that the gross return of the farmer has increased if they joined hands through collective action for natural resource restoration work like tank rehabilitation. The same will further imputes if the university extension service also supplied. The most noteworthy finding of the study was that quantification of the impact of the collective action and action research in the judicious use of scarce natural resource like water on the gross returns realized by the farmers. As revealed in the table the collective action coupled with action research has contributed additionally around Rs. 97 for the use of every hectare centimeter of water. This also highlights the complementarily of collective action and extension services in enhancing the farm income through the use of natural resources.

Table 5: Gross Return in Different Interventions Scenario

Intervention Scenarios	Gross Return
Control	84970.11
CAPAR	107134.72
CAO	95331.40

Note: CAPAR = collective action plus action research; CAO = collective action only

The result is summarized in the Table 5 that the gross return of the farmer from control scenario was Rs. 84970 where as the gross return of the farmers was Rs. 95331 in CAO scenario. The gross return of the farmer from CAPAR was

Rs. 107135. The difference between gross returns of CAPAR and control was around ` 22000 where as the difference between CAO and control scenario was around Rs. 10000. So the contribution of UAS research was found to be Rs. 2351 per acre whereas contribution of collective action was found to be around Rs. 4415 per acre.

SUMMARY AND CONCLUSIONS

Ratio of external to internal resources for paddy was highest in case of CAPAR scenario with 1.33 then in CAO scenario with 1.25 where as it was 0.98 in control. The return per rupee invested for paddy was highest in case of CAPAR scenario with 1.23 then in CAO scenario with 1.16 and lowest in control with 1.11 because of the less cost of cultivation and the higher yield in case of the CAPAR scenario, in CAO scenario and it was vice versa in control. The cost of cultivation per acre was highest in paddy crop with Rs. 20978, Rs. 21791 and Rs. 22005 in collective action plus action research (CAPAR), collective action only (CAO) and control respectively. The farmer from CAPAR scenario and in CAO scenario used more of external resource than the internal resource for ragi. Net return over variable cost of ragi per acre was Rs. 4639, Rs. 3301 and Rs. 2507 in CAPAR, CAO and control respectively. Per farm gross returns have enhanced by Rs. 22165 in CAPAR and Rs. 10361 in CAO than control. Return per rupee investment was highest in case of maize with 1.37, 1.22, 1.13 in CAPAR, CAO and control respectively. The contribution of collective action and action research together was Rs. 4415 per acre where as the contribution of research was Rs. 2351 per acre. Every hectare centimeter of water applied through CAPAR realized a higher gross return of Rs. 97.72.

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